ON NOMINAL AND REAL DEVALUATIONS RELATION: AN ECONOMETRIC EVIDENCE FOR PAKISTAN

SHAHBAZ, Muhammad *

Abstract

Economy can be affected by the process of devaluation or depreciation of local currency either positively or negatively. The improvement in trade balance is considered as one of the significant and beneficial impacts occurring on account of devaluation by means of an increase in the volume of exports while reduction in the volume of imports. However, higher inflation would lead to expensive imports that offset the growth of economy resulting from increase in the exports. This reduces the effectiveness of devaluation in bringing down trade deficit. The benefits of devaluation are restricted where inflation severely hits the economy. Moreover, nominal devaluation improves the trade balance when it leads to real devaluation.

The relationship between nominal and real effective exchange rates is explored in the present hypothesis. The study is a unique attempt in the case of Pakistan as devaluation has always been a politically sensitive issue. In this paper investigation, regarding "whether nominal devaluation leads the real devaluation or not" both in long run and in short span of time is done. The order of integration has been found through Ng-Perron (2001), whereas ARDL and DOLS are employed for long run correlations. The findings of the paper clearly indicate the fact that nominal devaluation not only leads to real devaluation in long run but also in short span of time. This scenario provides directions for policy-makers to take into consideration both positive and negative implications of devaluation in Pakistan.

JEL Classification: Devaluation, Unit Root, Co-integration
Key Words: F10, C20, C22

* Research Officer at Social Policy and Development Center at Karachi, Pakistan

1.- Introduction

Pakistan is an economy where average inflation was more than 9 percent per annum while trade deficit was US $ 6104 millions during 1971-2005. In 2007, inflation was 10.3 percent inflation prevailed in the economy and trade deficit was US $ 9495 millions[1]. Pakistan's exports grew at an average rate of 16.4 per cent annually over 2002-2006 but imports also continue to be pushed at an unprecedented level due to rise in oil prices. As well as, imports of food items are rising due to increase domestic demand alongwith supply shocks. Furthermore, in 2007, growth rates of exports and imports were 11.4 % and 29.7 % respectively that shows heavy reliance on import goods. To improve the trade balance, Pakistan adopted the managed floating exchange rate policy in 1980s while 1990s was the era of flexible exchange rate, which linked the local currency with international market. It may be presumed that an economy devalues or depreciates its currency either in fixed exchange rate or flexible exchange rate regimes to improve the trade balance.

Literature Review

Relevant economic literature reveals that nominal devaluation should improve the trade balance of an economy by making exports cheaper in international markets in terms of international market prices which increases the volume of exports. On the other side of the coin, nominal devaluation makes imports more expensive that leads to less import in terms of domestic currency. While inflationary pressures in the economy always eaten up beneficial impacts of nominal devaluation. *Macro-analysis suggests that nominal exchange rate needs to be adjusted for variations in local and international prices. After adjustment, nominal devaluation policy would be effective and improve the trade balance, if nominal devaluation leads to real devaluation [*Bahmani-Oskooee, (1998); *Bahmani-Oskooee and Gelan, 2007].*

Recent relevant literature reveals an unconvincing scenario and has empirical evidence for the linkage between nominal and real

[1] See IFS (2007) and WDI (2007) for data information.

devaluations. Vaubel, (1976) opens new direction in international trade & finance through an argument that nominal devaluations were effective to escort real devaluations during 1959-1975. Similarly; Connolly and Taylor, (1976, 1979); Bruno, (1978) & Edwards, (1988, 1994) conclude that nominal devaluation leads to real devaluation only in the short span of time to medium term. Grauwe and Holvoet (1978) collect input-output tables for European Community and conclude that under zero wage indexation, 0.70 per cent real devaluation has led by 1 per cent increase in nominal devaluation. While with the complete wage indexation, 1 per cent increase in nominal devaluation occurs to 0.5 per cent real changes in exchange rate. On the contrary, Donovan (1981); Bautista (1981) and Morgan & Davis (1982) claim that lead impact of nominal devaluation on real devaluation begins to erode in long span of time[2]. Kent and Naja (1998) commented that nominal devaluation leads more real devaluation as country moves to more flexible exchange rate regime but their findings about Pakistan are inconclusive for such relationship.

Bahmani-Oskooee and Mirzai (2000) apply KPSS test to see changes in real effective exchange rate and confirm the existence of PPP in most developing economies. Bahmani-Oskooee (2001) assesses long run response of trade balance to nominal devolutions in case of Middle Eastern Countries. Bahmani-Oskooee and Miteza (2002) use error-correction modeling to explore the gossip between nominal effective exchange rate and real effective exchange rate not only in short run but also for long run in less developed economies including Pakistan. They argue that nominal devaluation leads to real devaluation with insignificant values of variables in the case for Pakistan over 1971-1997 periods. Holmes, (2004) finds long run association between running actors but in most African economies nominal devaluation does improve real devaluation.

Bahmani-Oskooee and Gelan, (2007), have come to the conclusion that nominal devaluation is associated with real devaluation in medium to long run. But in short run, nominal effective exchange

[2] See for more details (Morgan & Davis, 1982)

rate changes do not lead the real effective exchange rate changes except in few African countries. The relationship between nominal and real devaluation has also been investigated in MENA countries by Bahmani-Oskooee and Kandi (2007) through the validity of Purchasing Power Parity. They conclude that nominal changes in exchange rate would have lead impact to the real effective exchange rate. Bahmani-Oskooee and Harvey (2007), construct quarterly data of concerned variables over the 1971-2004 period for less developed countries. They show significant impact of nominal depreciation on real depreciation for countries in the sample.

Rising trends in trade deficit is a burning issue in Pakistan with respect to international economics and finance. It is necessary to investigate the relationship between nominal and real effective exchange rate changes empirically. This study is a unique exercise that explores long and short run association between differences in nominal and real effective exchange rates. Most advanced unit root test Ng-Perron is employed to find out the order of integration. For long run association, ARDL (*Autoregressive Distributive Lag Model*) & DOLS (*Dynamic Ordinary Least Squares*), ECM (Error Correction Method) for short run and Variance Decomposition are also utilized to examine the percentages of innovative shocks. Section-II describes the methodological framework of the study; Section-III explains results of conjunction of variables. Finally, conclusion is summarized in section IV**.**

2. Modeling and Methodological Framework

Bowers and Pierce (1975) suggested that Ehrlich's (1975) findings with a log-linear specification are sensitive to functional form. However, Ehrlich (1977) and Layson (1983) argue on theoretical and empirical grounds and, conclude that the log-linear form is superior to the linear form. Both Cameron (1994) and Ehrlich (1996) suggest that a log-linear form is more likely to find evidence of a deterrent effect than a linear form. This makes our results more favorable to the deterrence hypothesis. Log-linear modeling specification utilized in present unique endeavor in context of small developing economy like Pakistan as portrays below. In the light of above discussion, algebraic equation for empirical investigation is being modeled as following;

$$LREER = \alpha_{\circ} + \alpha_1 LNEER + \varepsilon_t \qquad (1)$$

Where;
REER = *Real Effective Exchange Rate,*
NEER = *Nominal Effective Exchange Rate*

Table-1. Correlation Matrix and Descriptive Statistics

Variables	LREER	LNEER
LREER	1.0000	0.9453
LNEER	0.9453	1.0000

Variables	Mean	Median	Maxima	Minima	Std. Dev.	Kurtosis
LREER	4.7799	4.7042	5.4319	4.1597	0.2927	2.7865
LNEER	4.9910	5.0431	5.8464	3.4502	0.5403	3.1382

Table-1 represents the correlation matrix and descriptive statistics indicating that there is positive and strong association between nominal and real effective exchange rates. The high correlation between said actors confirms the existence of hypothesis that prices of goods and services adjust sluggishly relative to asset prices such as nominal exchange rate in Pakistan under floating exchange rate regime. Data of both variables have been collected from International Financial Statistics (IFS, 2006) and study period of this particular pioneering idea is 1981Q1-2006Q4.

2.1: Ng-Perron Test

Recently developed Ng-Perron (2001) unit root test has been utilized to investigate the e order of integration for running actors in the model (*Theoretical formation of Ng-Perron is based on Joseph and Sinha, 2006*). The Ng-Perron test has good size and explaining power. This test is particularly suitable for small samples. To describe the Ng-Perron test, augmented Dickey-Fuller test (ADF) (Dickey and Fuller, 1979, 1981) is started:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots\cdots + \beta_p \Delta y_{t-p} + v_t \quad (2)$$

This particular test has null hypothesis assuming $\alpha = 0$ while the alternative hypothesis $\alpha < 1$ utilizing the predictable t-test. Since the statistics does not follow the traditional student's t-distribution, Dickey and Fuller (1979) and Mackinnon (1996), among others, critical values are reproduced. In the estimation of ADF test, we can include a constant or a linear time trend and both constant and linear trend. Elliot, Rothemberg and Stock (1996) make amendments to modify the ADF tests for a constant and, constant and a trend. First, a quasi-difference of y_t in defined. The quasi-difference of y_t depends on the value of α representing the specific point against which the null hypothesis below is tested.

$$d(y_t/a) = y_t \; if \; t = 1 \; and \; d(y_t/a) = y_t - ay_t \; if \; t > 1 \quad (3)$$

Second, quasi-differenced data $d(y_t/a)$ is regressed on quasi-difference as follows:

$$d(y_t/a) = d(x_t/a)'\delta(a) + \eta_t \quad (4)$$

Where x_t involves with a constant or a constant and a trend. Let $\hat{\delta}(a)$ be the OLS estimate of $\delta(a)$. For a, ERS recommend using $\alpha = \overline{\alpha}$ where $\overline{\alpha} = 1 - 7/T$ if $x_t = \{1\}$ and $\overline{\alpha} = 1 - 13.5/T$ if $x_t =$ {1, t}. GLS detrended data, y_t^d are defined as follows $y_t^d \equiv y_t - x_t'$. In the ERS, GLS de-trended y_t^d is substituted for y_t.

$$\Delta y_t^d = \alpha \Delta y_{t-1}^d + \beta_1 \Delta y_{t-2}^d \Delta y_{t-1} + \cdots\cdots + \beta_P \Delta y_{t-P}^d + v_t \quad (5)$$

Like ADF test, the GLS unit root test also relies the coefficient value of α. The ERS point optimal test is as follows let the residuals from equation (3) be $\hat{\eta}_t(a) = d(y_t/a) = d(x_t/a)'\hat{\delta}(\overline{\alpha})$ and let the sum of squared residuals, $SSR(\alpha) = \hat{\eta}_t^{\,2}(\alpha)$. $\alpha = 1$ is the null hypothesis of optimal point test while possibility of alternative hypothesis contains $\alpha = \overline{\alpha}$. $P_t = (SSR(\overline{\alpha}) - SSR(1)/f_0$ which is test statistic, where f_0 an approaches to zero. The test of Ng-Perron contains of the following four unit root tests based on modifications: Phillips-Perron Z_a *and* Z_t, Bhargava R_1 and ERS optimal point tests. The tests are based on GLS de-trend data, Δy_t. First, let us define

$$k = \sum_{t-2}^{T} (y_{t-1}^{d})^2 / T^2$$

The four statistics are listed below.

$$MZ_\alpha^d = (T^1 y_T^d)^2 - f_0)/2k$$

$$MZ_t^d = MZ_\alpha \times MSB$$

$$MSB^d = (k/f_0)^{1/2}$$

$$MP_T^d = (\bar{c}^2 k - \bar{c}T^1)(y^d T)^2 / f_0 \; if \; x_t = \{1\}$$

and $MP_T^d = (\bar{c}^2 k + (1-\bar{c})T^1)(y^d T)^2 / f_0 \; if \; x_t = \{1,t\}$ where $\bar{c} = -7$ if $x_t = \{1\}$ and $\bar{c} = -13.5$ if $x_t = \{1,t\}$

2.2: ARDL Approach for Co-integration[3]

In economic literature, many methods are available for conducting the Co-integration test; the most widely used methods include the residual based Engle-Granger (1987) test, and Maximum Likelihood based Johansen (1991; 1992) and Johansen-Juselius (1990) tests. All these require that the variables in the system be of equal order of integration. The residual-based co-integration tests are inefficient and can lead to contradictory results, especially when there are more than two *I(1)* variables under consideration. In addition these methods do not include the information on structural break in time series data and suffer from low predicting power. It goes without saying that

[3] This theoretical formation of ARDL is based on Chandan, (2001)

structural changes is of considerable importance in the analysis of macroeconomic time series. Structural changes occur in many time series for any number of reasons including economic crises changes in institutional arrangements, policy changes regime shift war. An associated problem with this is the testing of the null hypothesis of structural stability against the alternative of a one-time structural break. If such structural changes are present in the data generating process, but not allowed for in the specification of an econometric model, results may be biased towards the erroneous non-rejection stationary hypothesis (Leybourne and Newbold, 2003; Perron, 1989, 1997).

Recently, an emerging body of literaure led by Pesaran and Pesaran (1997), Pesaran, Shin and Smith (2000), Pesaran and Shin (1999), and Pesaran et, al,. (2001) has introduced an alternative Co-integration technique known as the "Autoregressive Distributive Lag" or ARDL bounds testing. It is argued that ARDL has a numerous advantages over conventional techniques like Engle-Granger and Johansen Co-integration approaches. The first advantage of ARDL is that it can be applied irrespective of whether underlying regressors are purely *I(0)*, purely *I(1)* or mutually co-integrated (Pesaran and Pesaran, 1999). The second advantage of using the bounds testing approach to Co-integration is that Monte Carlo studies that it performs better than Engle and Granger (1987), Johansen (1990) and Philips and Hansen (1990) Co-integration test in small samples (see for more details Haug, 2002). The third advantage of this approach is that, the model takes sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson and Chai, 2003). Finally, ARDL is also having the information about the structural break in time series data. However, Pesaran and Shin (1999) contented that, "appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous variables".

Under certain environment, Pesaran and Shin (1995) latter on by PSS (Pesaran, Shin and Smith, 2001) established that long run association among macroeconomic variables may be investigated by employing the Autoregressive Distributive Lag Model. After the lag order for ARDL procedure, OLS may be utilized for estimation and identification. Valid estimation and inference can be drawn through presence of unique long run alliance that is crucial. Such inferences not only on long run but also on short run coefficients may be made which concluded that the ARDL model is correctly augmented to account for contemporaneous correlations between the stochastic terms of the data generating process (DGP) included in the ARDL estimation. It is concluded that ARDL estimation is possible even where explanatory variables are endogenous. Moreover, ARDL remains valid irrespective of the order of integration of the explanatory variables. But ARDL procedure will collapse if any variable is integrated at *I(2)*.

The PSS (2001) procedure is implemented to estimate error correction model given such an equation:

$$REER = \alpha_{\circ} + \sum_{i=1}^{n} \beta_i \Delta REER_{t-i} + \sum_{j=1}^{m} \sum_{i=1}^{p} \phi_{ji} \Delta NEER_{t-1} + \left(\delta_1 REER_{t-1} + \sum_{j=1}^{k} \gamma_1 NEER_j \right) + \eta_t$$

(6)

PSS F-test is estimated by imposing zero-joint restriction on $\delta 's$ in error correction model. Distribution of PSS F-test is non-standard (Chandan, 2001). The reason is that lower and upper critical bounds are generated by PSS (1996). Lag order of ARDL model is selected on lower value of AIC or SBC. After empirical estimation, if PSS (2001) confirms the presence of unique cointegration vector among variables. This shows that one is outcome variable while other is forcing actor in model. On basis of selected ARDL, long run and short estimates can investigated in two steps (Pesaran and Shin, 1995).

Assuming that an ARDL(p,q) just for which presence of association between x_t & y_t for <u>*long span of time*</u> has been recognized. Long run relationship for said actors can be established by estimating ARDL model as given by means of Ordinary Least Squares (OLS):

$$REER = \varpi + \sum_{i=1}^{p} \beta_i REER_{t-1} + \sum_{i=0}^{q} \vartheta_i NEER_{t-i} + \nu_t \quad (7)$$

Where v is normally distributed error term. Long run (cointegration) coefficients can be obtained:

$$REER = \alpha + \rho NEER + \mu_t \quad (8)$$

from:

$$\hat{\alpha} = \frac{\hat{\varpi}}{1 - \sum_{i=1}^{p} \hat{\beta}_i}, \qquad \& \qquad \hat{\rho} = \frac{\sum_{i=0}^{p} \hat{\rho}_i}{1 - \sum_{i=1}^{p} \hat{\beta}_i} \quad (9)$$

Firstly, we try to find out the direction of relationship between nominal effective exchange rate and real effective exchange rate in the case of Pakistan by analyzing the PSS F-test statistics. The calculated *F-statistic* is compared with the critical value tabulated by Pesaran and Pesaran (1997) or Pesaran *et al*. (2001). If the *F*-test statistic exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of whether the underlying orders of integration of the variables are *I(0)* or *I(1)* . Similarly, if the *F*-test statistic falls below the lower critical value, the null hypothesis is not rejected. However, if the sample *F-test* statistic falls between these two bounds, the result is inconclusive. When the order of integration of the variables is known and all the variables are *I(1)*, the decision is made based on the upper bounds. Similarly, if all the variables are *I(0),* then the decision is made based on the lower bounds.

The ARDL method estimates $(p+1)^k$ number of regressions in order to obtain optimal lag length for each variable, where *p* is the maximum number of lags to be used and *k* is the number of variables in the equation. The model can be selected using the model selection criteria like Schwartz-Bayesian Criteria (SBC)[4] and Akaike's

[4] The mean prediction error of AIC based model is 0.0005 while that of SBC based model is 0.0063 (Min B. Shrestha, 2003).

Information Criteria (AIC). SBC is known as the parsimonious model: selecting the smallest possible lag length, whereas AIC is known for selecting the maximum relevant lag length. In the second step, the long run relationship is estimated using the selected ARDL model. When there is a long run relationship between variables, there should exist an error correction representation.

Therefore, finally, the error correction model is estimated. The error correction model result indicates the speed of adjustment back to the long run equilibrium after a short run shock. To ascertain the goodness of fit of the ARDL model, the diagnostic tests are conducted. The diagnostic or sensitivity tests examine the serial correlation, autoregressive conditional heteroscedisticity, normality and heteroscedisticity associated with the model.

2. 3: Dynamic Ordinary Least Squares Model (DOLS)

To observe the robustness of long run rapport, DOLS (Ordinary Least Squares) Model employed developed by Stock and Watson (1993) for the investigation of long run relationships among dependent variable and explanatory variable. This procedure involves regressing the dependent variable on constant and explanatory variable on levels, leads and lags of the first difference of all *I(1)* explanatory variables (Masih and Masih, 2000). This method is superior to a number of other estimators as it can be applied to systems of variables with different orders of lags (Stock-Watson, 1993). The inclusion of leads and lags of the differenced explanatory variable corrects for simultaneity, endogeneity, serial correlation and small sample bias among the regressors (Stock and Watson, 1993). DOLS estimates and t-statistics have better small sample properties and provide superior approximation to normal distribution (Stock and Watson, 1993). The specification of DOLS model is follows given below:

$$REER_t = \varphi_\circ + \varphi_1 NEER_t + \sum_{j=-p}^{p} \phi_j \Delta NEER_{t-1} + \eta_t \ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

Where $REER_t$ is real effective exchange rate, $NEER_t$ is a nominal effective exchange rate and Δ is lag operator.

3. Empirical Interpretation Design

ARDL has the advantage of avoiding the classification of variable into *I (0)* or *I(1)* since there is no need for unit root pre-testing. As argued by Sezgin and Yildirim, (2002) that ARDL can be applied regardless of stationary properties of variables in the sample and allows for inferences on long run estimates, which is not possible under alternative Co-integration techniques. In contrast, according to Ouattara (2004) in the presence of *I(2)* variables the computed F-statistics provided by PSS (2001) become invalid because bounds test is based on the assumption that the variables should be *I(0)* or *I(1)*. Therefore, the implementation of unit root tests in the ARDL procedure might still be necessary in order to ensure that none of the variable is integrated of order *I(2)* or beyond.

For this purpose, Ng-Perron (2001) test employed which is more powerful and reliable for small data set. Mostly in literature to find out the order of integration ADF (Dicky & Fuller, 1979), P-P (Philip & Perron, 1988) and DF-GLS (Elliot, et, all, 1996) tests are often used respectively[5]. Due to the poor size and power properties, both tests are not reliable for small sample data set (Dejong et al, 1992 and Harris, 2003). They concluded that these tests seem to over-reject the null hypotheses when it is true and accept it when it is false. Therefore, Ng-Perron test utilized to overcome these above-mentioned problems about order of integration of running actors in the model alongwith ADF & P-P tests. The results described in Table-A2 in the Annex, showing that nominal effective exchange rate and real effective exchange rate are having 1st order of integration.

[5] We also utilized these three tests but decision is based on Ng-Perron test.

Table-3. Lag Length Criteria

Lag order	Log likelihood	AIC	SBC
2	409.3483	-7.8303	-7.5730
3	410.7663	-7.8567*	-7.4942
4	406.4624	-7.7692	-7.3003
Sensitivity Tests Serial Correlation LM Test =2.1098(0.1268) ARCH Test =0.152042(0.6974) White Heteroscedisticity Test =13.4401(0.000) Normality J-B Value = 0.8186(0.6641)			

Note: Lag 3 is selected by AIC.

After finding integrating order of all variables, the two-step ARDL Co-integration (See Pesaran *et al.*, 2001) procedure is employed in the estimation of equation (6) for Pakistan by utilizing quarterly data over the period 1981Q1-2006Q4. In the first stage, the order of lag length on the first difference estimating the conditional error correction version of the ARDL model for equation-6 is usually obtained from unrestricted vector auto-regression (VAR) by means of Akaike Information Criteria (AIC) which is 3 based on the minimum value as shown in Table-3. In such small sample of observations we cannot take lag length more than 3 lag.

Table 4. ARDL Estimation for Long-run Relationship

Dependent Variable	Lag Order	F-statistics	Wald-Test (Prob-value)
LREER	2	7.089	6.791(0.002)
	3	4.939	4.673(0.012)
	4	3.0168	2.817(0.065)
Critical Values at 1 % (5 %) 10 % respectively			
Pesaran, at, al., (2001)		Narayan P (2005)	
Lower Bounds	Upper Bounds	Lower Bounds	Upper Bounds
2.840	4.100	3.728	5.160
2.330	3.460	2.885	4.111
2.070	3.160	2.504	3.631

DOLS Estimation for Long Run Association			
Variables	Co-efficient	t-value	Prob-value
Constant	2.185	23.548	0.0000
LNEER	0.517	28.226	0.0000
ΔLNEER(1)	-0.263	-2.053	0.0428
ΔLNEER(2)	-0.183	-1.444	0.1522
ΔLNEER(-3)	0.449	1.589	0.1155
R-square = 0.8976 Adjusted R-square = 0.8932 Akaike info criterion = -2.0313 F-statistic = 203.87			

The total number of regressions estimated following the ARDL method in the equation No.2 is $(2+1)^3 = 27$. The results of the bounds testing approach for Co-integration show that the calculated *F-statistics* is 4.939[6] which is higher than the upper level of bounds critical value of 4.350 and 4.515 (Pesaran, et, al (2001) and Narayan, P (2005) at the 5 percent level of significance respectively as given in Table-4. This implies that the null hypothesis of no Co-integration cannot be accepted and that there is indeed a co-integrating relationship among the variables in this model.

Both *NEER* and *NEER* are integrated at *I(1)* that led to support for implementation of DOLS approach. The results of DOLS (Dynamic Ordinary Least Square) are reported in lower part of Table-4; only significant regressors are shown, Adjusted-R^2 value of ***0.8932*** is an indication of good-fit for the dataset, the F-statistics-*203.87* (*Prob*-value = 0.00) is statistically significant at 1 percent level of significance. It is concluded that the explanatory variable (nominal devaluation) is having significant influence on real devaluation for a small developing economy like Pakistan. The results of DOLS regression show that in long run, nominal effective exchange rate stimulates real effective exchange rate more 51 percent (approximately results of DOLS are same as compare to OLS).

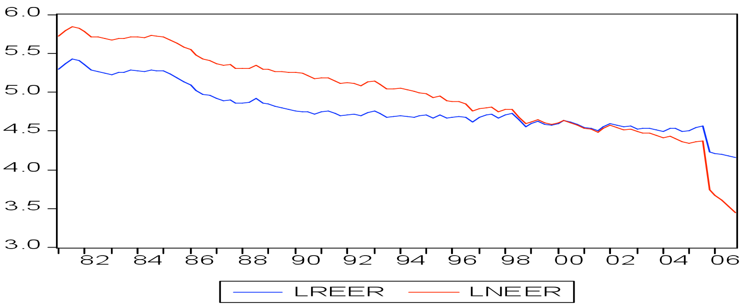
[6]As can be seen from Table-4, although the results of the *F-test* changes significantly at lag order 2, support for Co-integration is more. F-test statistics is highly sensitive with the lag order; there is strong evidence for Co-integration because our calculated *F-value* is grater than its critical value when third lag is imposed.

However, first lead impact of nominal effective exchange rate declines real devaluation. In long span of time, OLS has revealed that nominal currency devaluation leads real devaluation of local currency more than 51 percent while less than 49 percent share of real devaluation explains through the hidden factors. Stability values (Prob-values) are given in parentheses with coefficient of constant and NEER as given below. After the comparison of OLS and DOLS results, it is concluded that long run association of NEER with REER is robust.

$$LREER = 2.233(0.00) + 0.512(0.00)LNEER$$

R-squared = 0.8936 F-statistic = 856.54 AIC =-1.8303 SBC = -1.7795

Figure-1 graphical Behavior of REER and NEER



After establishing the long run relationship between nominal and real effective exchange rates in the case of Pakistan as mentioned in Table-4. Short run dynamics are investigated through an empirical equation being modeled as given below:

$$\Delta LREER = \lambda_{\circ} + \sum_{i=1}^{n} \Delta LREER_{t-i} + \sum_{i=0}^{n} \Delta LNEER_{t=i} + \eta ECT_{t-1} + \mu_t \quad \ldots (11)$$

Table-5 shows the short-run coefficient estimates obtained from the ECM version of ARDL model. The ECM coefficient shows how quickly/ slowly variables return to equilibrium and it should have a statistically significant coefficient with negative sign. The error correction term ECT_{t-1}, which measures the speed of adjustment to restore equilibrium in the dynamic model, appear with negative sign and is statistically significant at 5 percent level, ensuring that long run equilibrium can be attained. Kremers et al, (1992); Bannerjee et al., (1993) & Bannerjee et al., (1998) hold that a highly significant error correction term is further proof of the existence of stable long run relationship. Indeed, he has argued that testing the significance of ECT_{t-1}, which is supposed to carry a negative coefficient, is relatively more efficient way of establishing co-integration.

Table-5. Short Run Dynamics (3, 3)

Dependent Variable: ΔLREER

Variable	Coefficient	T-Statistic	Inst-Value
Constant	-0.0006	-0.2903	0.7722
ΔLREER(-1)	0.2733	2.7419	0.0073
ΔLREER(-2)	0.0753	0.7327	0.4655
ΔLNEER	0.6193	24.0095	0.0000
ΔLNEER(-1)	-0.2019	-2.9855	0.0036
ΔLNEER(-2)	-0.0971	-1.3912	0.1674
ECT_{t-1}	-0.0289	-1.5313	0.1291

R-squared = 0.871326 Adjusted R-squared = 0.863112
F-statistic = 106.0878 Durbin-Watson stat = 2.030146
Prob(F-statistic) = 0.000000 Akaike info criterion = -5.248532 Schwarz criterion = -5.067286

The coefficient of ECT_{t-1} is equal to (-0.0289) for short run model and implies that deviation from the long-term nominal devaluation is corrected by (2.89) percent over the each quarter at 12 percent level of significance for real devaluation. The lag length of short run model is selected on basis of both Akaike Information Criteria and Schwartz Bayesian Criteria. Real devaluation improves 27.33 percent through its differenced lag and nominal devaluation leads real devaluation by almost 62 percent with high significance while differenced lag of nominal effective exchange rate impacts negatively to dependent actor but this affect becomes positive in future.

Variance decomposition is an alternative method to impulse response function for investigating the response of dependent variable due to effects of shocks by explanatory actors [Diagram of Impulse Response Function (IRF) and Variance Decomposition of DLREER and DLNEER are is also given in Appendix-2]. This method explains that how much of predicted error variance for any variable is described by innovations generated through each independent variable in a system over the horizons.

The shocks also affect other variables in the system due to innovative shocks explained by error variance. Table-6 shows that fraction of Pakistani real devaluation forecast error variance attributable to variations in nominal devaluation is 0.00 percent respectively.

The descriptive influence of running actor, namely nominal effective exchange rate (nominal devaluation) increases till 20-time horizon. More than 91 percent real effective exchange rate explains by its own innovative shocks and vice versa. While fraction of Pakistani nominal devaluation forecast error variance attributable to variations in real devaluation is 14.13 percent respectively. Table-7 indicates that at 20-time horizons, nominal effective exchange rate changes 59 percent from its innovative and 41 percent approximately by real effective exchange rate.

4. Conclusions

The present unique hypothesis explores the association between nominal and real effective exchange rate changes. The structure established to examine *"whether nominal devaluation leads the real devaluation or not"* in the case of Pakistan both in long run as well as in short span of time. Results of this study reveal that nominal devaluation not only leads to real devaluation in longer periods but also in short span of time. Real effective exchange changes explained 92 percent approximately through its own innovative shocks while nominal effective exchange rate 59 percent by its shocks and 41 percent in the course of real effective exchange rate's innovative shocks.

In the context of policy implications, average inflation in Pakistan is more than 9 % that captures improving impact of nominal

devaluation and making the exports more expensive. Low quality of export goods together with low-profitable exports will deteriorate the trade balance. Government should need to formulate some adjustments in inflation[7] for long period of time through a comprehensive policy to obtain the beneficial impacts of nominal devaluation in the form of improvements in real devaluation generally and to improve the trade balance particularly.
Government must adopt demand management policies to curtail the domestic demand. Supply shocks will be low if aggregate demand is low and in resulting inflation will be under controlled. Curtailed demand will improve exports bas in international markets and decrease the import volume. In this scenario, nominal devaluation policies will be effective in improving the trade balance and lead to real devaluation.

Reference

Bahmani-Oskooee, Mohsen and Harvey, (2007), "Real and Nominal Effective Exchange Rates for LDCs: 1971-2004" International Trade Journal, Issue-4, pp: 385-416.
Bahmani-Oskooee, Mohsen and Kandi (2007), "Real and Nominal Effective Exchange Rates in MENA countries: 1970-2004" Applied Economics, Issue-19, pp: 2489-2501.
Bahmani-Oskooee, Mohsen and Mirzai (2000), "Real and Nominal Effective Exchange Rates for Developing Economies: 1973-1997" Applied Economics, Issue-4, pp: 411-28.
Bahmani-Oskooee, Mohsen and Miteza, I. (2002), "Do Nominal Devaluations Lead to Real Devaluations in LDCs?", Economics Letters, 74:385–91.
Bahmani-Oskooee, Mohsen, (2001), "Nominal and Real Effective Exchange Rates in Middle Eastern Countries and Their Trade Balance" Applied Economics, Issue-1, pp: 103-11.
Bahmani-Oskooee, Mohsen. and Gelan, A. (2007), "On the Relation between Nominal Devaluation and Real Devaluation: Evidence from African Countries", Journal of African Economies, 16 (2): 177- 197.
Banerjee, A. and Newman, A. (1993), "Occupational Choice and the Process of Development", Journal of Political Economy, 101(2):274-98.

[7] There is also need to redefine the formula of core inflation.

Bannerjee, A., J. Dolado and R. Mestre, (1998), "Error-correction Mechanism Tests for Co-integration in Single Equation Framework", Journal of Time Series Analysis, 19, 267-83.

Bautista, (1981), "Exchange Rate Changes and LDC Export Performance under Generalized Currency Floating", Weltwirtschaftliches Archives, 117, pp: 443-468.

Bowers, W. and Pierce, G., (1975), "The Illusion of Deterrence in Isaac Ehrlich's Work on the Deterrent Effect of Capital Punishment", Yale Law Journal, 85, 187-208.

Bruno, M. (1978), "Exchange Rates, Import Costs, and Wage-Price Dynamics", Journal of Political Economy, 86: 379–403.

Cameron, S., (1994), "A Review of the Econometric Evidence on the Effects of Capital Punishment", Journal of Socio-economics, 23: 197-214.

Chandana Kularatne, (2001), "An Examination of the Impact of Financial Deepening on Long-Run Economic Growth: An Application of a VECM Structure to a Middle-Income Country Context" 2001 Annual Forum at Misty Hills, University of the Witwatersrand, Johannesburg.

Charemza, W. W. and Deadman, D. F. (1992), "New Directions in Econometric Practice: General to Specific Modeling, Co-integration and Vector Auto-regression", Aldershot, Edward Elgar.

Christopher Kent and Rafic Naja, (1998), "Effective Exchange Rates and Irrelevant Nominal Exchange rate Regime" Research Discussion Paper-11, Reserve Bank of Australia.

Connolly, M. and Taylor, D. (1976), "Adjustment to Devaluation with Money and Non-Traded goods", Journal of International Economics, 6: 289–98.

Connolly, M. and Taylor, D. (1979), "Exchange Rate Changes and Neutralization: A Test of the Monetary Approach Applied to Developed and Developing Countries", Economica, 46: 281–94.

De Grauwe, Paul and Holvoet, (1978), "On the effectiveness of a devaluation in the E.C.-countries", Tijdschrift voor Economie en Management vol:23 issue:1 pages:67-82.

Dejong, D.N., Nankervis, J.C., Savin, N.E., (1992), "Integration Versus Trend Stationarity in Time Series", Econometrica, 60, 423-33.

Dickey, D. A., and W. A. Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", Econometrica, 49, 1057-1072.

Dickey, D., Fuller, W.A., (1979), "Distribution of the Estimates for Autoregressive Time Series with Unit Root", Journal of the American Statistical Association, 74 (June), 427-31.

Donovan, (1981), “Real Response associated with Exchange rate Action in Selected Upper Credit Tranche Stabilization Programme” IMF Staff Working Papers, 28, pp: 67-82.

Edwards, S. (1988). “Real and Monetary Determinants of Real Exchange Behavior: Theory and Evidence from Developing Countries.” Journal of Development Economics, 29: 311 – 341.

Edwards, S. (1994). “Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries.” In J. Williamson (eds.). Estimating Equilibrium Exchange Rates. Washington, D.C.: IIE. (Chapter 4)

Ehrlich, I., (1975), “The Deterrent Effect of Capital Punishment – A Question of Life and Death”, American Economic Review, 65: 397-417.

Ehrlich, I., (1977), “The Deterrent Effect of Capital Punishment Reply”, American Economic Review, 67: 452-58.

Ehrlich, I., (1996), “Crime, Punishment and the Market for Offences”, Journal of Economic Perspectives, 10: 43-67.

Elliot, G., Rothenberg, T.J., Stock, J.H., (1996), “Efficient Tests for an Autoregressive Unit Root”, Econometrica, 64, 813-36.

Engle, R. F, Granger C. W. J. (1987), “Cointegration and Error Correction Representation: Estimation and Testing”, Econometrica, 55: 251–76.

Harris, R., Sollis, R., (2003), “Applied Time Series Modeling and Forecasting” Wiley, West Sussex.

Haug, A. (2002), “Temporal Aggregation and the Power of Co-integration Tests: A Monte Carlo Study”, Oxford Bulletin of Economics and Statistics, 64: 399-412.

Holmes, M. J. (2004), “Can African Countries Achieve Long-Run Real Exchange Rate Depreciation Through Nominal Exchange Rate Depreciation?”, The South African Journal of Economics, 72: 305–23.

Johansen, S. (1992), “Co-integration in Partial Systems and the Efficiency of Single-Equation Analysis” , Journal of Econometrics, 52: 389–402.

Johansen, S., (1991), “Estimation and hypothesis testing of co-integrating vectors in Gaussian vector autoregressive models”, Econometrica, 59: 1551–80.

Johansen, Soren and Katarina Juselius (1990). “Maximum Likelihood Estimation and Inference on Cointegration- with Applications to the Demand for Money”, Oxford Bulletin of Economics and Statistics 52(2): 169-210.

Joseph and Sinha, (2006), “Does Black’s Hypothesis for Output Variability Hold for Mexico?” mimeo.

Kent C., Naja R., (1998), “Effective Real Exchange Rates and Irrelevant Nominal Exchange Rate Regimes”, Research Discussion paper n. 9811.

Kremers, J. J. M., Ericsson, N. E., Dolado, J. J. (1992), "The Power of Co-integration Tests" , Oxford Bulletin of Economics and Statistics, 54: 325-48.
Laurenceson, J. and Joseph, C. and Chai, H. (2003), "Financial Reform and Economic Development in China", Cheltenham, UK, Edward Elgar.
Layson, S., (1983), "Homicide and Deterrence: Another View of the Canadian Time Series Evidence", Canadian Journal of Economics, 16: 52-73.
Leybourne, S. and Newbold, P. (2003) "Spurious rejections by cointegration tests induced by structural breaks", Applied Economics, 35, 1117-1121.
Masih, A. M. M. and Masih, R. (1996), "Energy Consumption, Real Income and Temporal Causality", Energy Economics, 18: 165-83.
McKinnon, R. I., (1973), "Money and Capital in Economic Development", Washington, D.C., The Brookings Institution.
Min. B. Shrestha, (2003), "ARDL Modeling Approach to Co-integration Test".
Mohsen Bahmani-Oskooee, (1998), "Are Devaluations Contractionary in LDCs?", Journal of Economic Development, Volume 23, Number 1, pp: 131-38.
Morgan and Davis, (1982), "The Concomitants of Exchange Rate Depreciation: Less Developed Economies, 1971-1973", Economic Development and Cultural Change, 31, pp: 101-130.
Narayan, Paresh Kumar (2005), "The saving and investment nexus for China: evidence from co-integration tests", Applied Economics, 37:17, 1979-1990.
Ng, S., Perron, P., (2001), "Lag Length Selection and the Construction of Unit Root Test with Good Size and Power", Econometrica, 69, 1519-54.
Ouattara, B., (2004), "Foreign Aid and Fiscal Policy in Senegal". Mimeo University of Manchester.
Perron, P. (1989), "The great crash, the oil price shock, and the unit root hypothesis", Econometrica, 57, pp.1361-1401.
Perron, P. (1997), "Further Evidence on Breaking Trend Functions in Macroeconomic Variables", Journal of Econometrics, 80 (2), pp.355-385.
Pesaran M. H., Shin Y., Smith, R. J. (2000), "Structural Analysis of Vector Error Correction Models with Exogenous I(1) Variables", Journal of Econometrics, 97: 293–343.
Pesaran, M. H. and Shin, Y. (1999), "An Autoregressive Distributed Lag Modeling Approach to Co-integration Analysis", in (eds), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, Strom S (ed.). Cambridge University Press: Cambridge.

Pesaran, M. H., Pesaran, B. (1997). “Working with Microfit 4.0: Interactive Econometric Analysis”, Oxford: Oxford University Press.
Pesaran, M. H., Shin, Y. and Smith, R. J. (2001), “Bounds Testing Approaches to the Analysis of Level Relationships”, Journal of Applied Econometrics, 16: 289–326.
Pesaran, M.H., and Shin, Y., (1995), Long run structural modeling, unpublished manuscript, University of Cambridge.
Pesaran, M.H., Shin, Y., and Smith, R. J., (1996), “Testing for the existence of a long run relationship”, DAE Working Paper No 9622, Department of Applied Economics, University of Cambridge.
Phillips, P. C. B., Hansen, B. E. (1990). “Statistical inference in instrumental variable regression with I (1) Processes”. Rev. Econ. Studies 57:99.125.
Phillips, P.C.B. and P. Perron (1988), “Testing for a unit root in time series regression,” Biometrika, 75, 335-346.
Selami Sezgin and Julide Yildirm, (2002), “The Demand for Turkish Defence Expenditure”, Defence and Peace Economics, 2002, Vol. 13(2), pp. 121–128.
Stock, J. H. and Watson, M. W. (1993), “A Simple Estimator of Co-integrating Vectors in Higher Order Integrated Systems”, Econometrica, 61 (4): 783-820.
Vaubel, R. (1976), “Real Exchange Rate Changes in the European Community: The Empirical Evidence and its Implications for European Currency Unification”, Weltwirtschaftliches Archiv, 112:429–70.

Appendix 1

Table-A2. Unit Root Estimation

Variables	ADF test at Level		P-P test at Level	
	T. Statistics	Prob-value	T. Statistics	Prob-value
LREER	-2.0026	0.5927	-2.0405	0.5721
LNEER	-0.3208	0.9891	-0.6737	0.9719
Ng-Perron Test at Level				
Variables	MZa	MZt	MSB	MPT
LREER	-8.3136	-1.9787	0.2380	11.1585
LNEER	-3.5890	-0.7739	0.2156	18.0418
ADF & P-P Tests at 1st Difference				

LREER	-9.9081	0.0000	-9.9626	0.0000
LNEER	-9.7391	0.0000	-9.7414	0.0000
Ng-Perron Test at 1st Difference				
Variables	MZa	MZt	MSB	MPT
LREER	-48.3652*	-4.91506	0.1016	1.8968
LNEER	-49.3262*	-4.96561	0.1007	1.8503

Note: * represents significance at 1% level.

Appendix-2

Table-6. Variance Decomposition of DLREER

Period	S.E.	DLREER	DLNEER
1	0.0462	100.0000	0.0000
3	0.0472	97.9940	2.0059
5	0.0474	97.3089	2.6910
7	0.0477	96.3870	3.6129
9	0.0479	95.6476	4.3523
11	0.0480	94.9039	5.0960
13	0.0482	94.1619	5.8380
15	0.0484	93.4357	6.5642
17	0.0486	92.7210	7.2789
18	0.0487	92.3675	7.6324
19	0.0488	92.0170	7.9829
20	0.0489	91.6691	8.3308

Table-7. Variance Decomposition of DLNEER

Period	S.E.	DLREER	DLNEER
1	0.069174	85.87347	14.12653
3	0.072706	78.51750	21.48250
5	0.076985	70.36251	29.63749
7	0.081021	63.79441	36.20559
9	0.084606	58.70168	41.29832
11	0.088105	54.32000	45.68000
13	0.091478	50.56416	49.43584
15	0.094724	47.32222	52.67778

16	0.096307	45.85894	54.14106
17	0.097864	44.48850	55.51150
18	0.099397	43.20146	56.79854
19	0.100906	41.99100	58.00900
20	0.102393	40.85039	59.14961